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# Product Photography for an Online Store and a Printed Catalog

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<p>The main purpose of this project was to produce a set of product photographs for a customer and prepare them for use in an online shop as well as in a printed catalog. The goal for this Bachelor Thesis was to collect theoretical information on all of the stages of product photography production workflow, plan a similar workflow for the project and implement it. Another goal was to find out the differences between photography production processes for two different outputs: a printed catalog and an online store.</p> <p>A portable product photography studio setup was used for the production of the photographs. The photographs were then edited and saved into two separate sets: one set for print and another set for web use. Test prints were done for the photographs saved for the printing purposes. Color management techniques were carried out on every stage of the production.</p> <p>In the end the results of the project were collected and analyzed. The differences in the production workflow for two different outputs were identified. The setup and processes used to implement the project have shown to produce acceptable results. Carefully color managed workflow has shown to improve the quality of production process while the portable lighting setup used was found to have some limitations.</p>	
Keywords	Product photography, studio photography, digital printing, color management

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## Definitions

ICC	International Color Consortium, a group of companies that created general color management guidelines that can be used across different platforms
Gamut	a range of colors a certain device is capable of producing
CMYK	Cyan, Magenta, Yellow and Black; primary colors of the subtractive color model used by printers and presses
RGB	Red, Green and Blue; primary colors of the additive color model used by displays, cameras and scanners



## **1 Introduction**

Product photography is a genre in commercial photography aimed to demonstrate products to business customers or to showcase items produced by an organization or a single person. Product photographs are used in online shops and portfolios as well as in printed and digital catalogs.

The goal of this project was to produce a set of product photographs for an online shop. The photographs requested by the customer were intended to be used both online and in a printed catalog. Therefore, another goal of this project was to compare photography production workflows for print and online use. During the course of this project theoretical research was done on different ways to produce product photographs in studio conditions, edit them and prepare for print and online use. Based on the theory studied the workflow for photography production was planned and carried out. The results of the process were then collected and analyzed.

The customer for this project was a small online shop selling vintage dolls based in Espoo, Finland. The online shop for this business is built on the Etsy.com platform, which is an online marketplace for art, handmade and vintage sellers. The main requirement for the photographs was to find the best way to photograph the dolls in order for them to look attractive to a buyer. Minimal use of props and a simple white background was recommended in order to fit within the Etsy.com marketplace aesthetics. A small amount of props, such as toy furniture, was provided by the customer.

Due to the nature of the product, only studio table top product photography was researched in in this project. No other types of product photography environment, such as model photography or nature product photography, were studied.

## **2 Product photography**

### **2.1 Production**

#### **2.1.1 Light**

The main aspect to concentrate on when working on product photography is light. Lighting the product properly is one of the biggest initial steps in creating good quality photographs. In product photography, as in all kinds of studio photography, the photographer has total control over the light, unlike when shooting outside or with other existing light. When working in a studio, a photographer has an opportunity to shape light in order to show the subject of the photographs the way he/she wants it to look like. [1,6]

There is no general way to light objects in product photography. Lighting depends a lot on the kind of object that is being photographed as well as the setting it is being photographed in. There are several characteristics that make objects differ from each other. Light surfaces reflect a lot of light while dark surfaces absorb it. Therefore, with light surfaces the photographer needs to create shadows in order to show the shape of the object, while with dark surfaces he/she needs to create highlights. With objects have shiny surfaces the shapes of all the light sources are be seen as reflections of the object's surface. Therefore, it is very important to choose the correct tools. Also when an object has a reflecting surface everything around it will be reflected, so it is important to keep an eye on things that should not be seen on the photograph, including the photographer him/herself. [2]

#### **2.1.2 Composition**

One of the advantages of product photography when talking about composition is the possibility to use more than one technique. This applies especially for web use. Online shops usually have several images for each product and each of the images is composed differently depending on what aspects of the product need to be shown.

There are several aspects to pay attention to when choosing good composition for product shots. When a product is sold online, customers do not have a possibility to touch it or look at it from different sides and distances. That is why the photographs

have to show as much of those details as possible for a customer to imagine what the product looks like in reality. One option is to show the product in use. That way the customer can see the size compared to other objects as well as what he/she can do with the product. Another way is to include images from different sides and angles, so that the customer can imagine the three-dimensional look of the product. Also macro shots can be useful to show the texture of the surface. [3]

Basic rules of creative composition apply to product photography as well as to any other genre. The rule of thirds is the most common guideline to balanced composition. According to this rule the frame should be visually divided in three equal parts with two horizontal lines and the same way with two vertical lines. Those lines and their intersection points should be used as guidelines to position the main elements in the frame. Placing subjects along other imaginable lines is also a way to gain balance in a shot. For example, horizontal and vertical lines give an illusion of stability while diagonal lines provide a sense of movement. Vertical lines also give the feeling of visual strength and support. Curved lines can soften the perception by slowing down the viewer's look along those lines. It is always good to experiment with different angles from which the camera looks at the subject for more creative and balanced composition. [4,29-31]

There are also various backgrounds and props that can enhance the composition. Using props can demonstrate how a product can be used in real life as well as create a certain atmosphere to go with the style of the products and the brand. Different surfaces can be used as backgrounds to add to the style and atmosphere as well. Printed images can also be used as backgrounds to imitate an environment in which a product should be used. With reflective objects some props might not even be used in the setting, but placed so that they are reflected on an object's surface to imitate a certain setting or environment. [1,52-53]

Having all that in mind, it is always important to keep the balance between creative staging and keeping the photographs informative. This depends greatly on the kind of products as well as the overall style of the shop or catalog. [1,6] Moreover, it is always good to have consistency within one shop, brand or catalog. For example, if a minimalistic style with only white background and a product slightly on the right is chosen, it should be used throughout the whole shop. On the other hand, if some of the products look better on models, it is a good idea to present all of them on models. With large shops that sell a lot of different items, the consistency can be held at least within shop sections.

### 2.1.3 Studio setup

#### Camera and lenses

For studio product photography basically any camera with manual exposure possibility is good enough as long as it is compatible with the lighting system that is used. It is however an advantage if the camera used is a DSLR, because a possibility to use multiple lenses gives more flexibility. Standard zoom lenses between 24 and 100 mm focal distance are the ones that are mostly used for product photography. Longer focal distances are usually too long for a studio. Wide angle lenses, on the other hand, may distort the image, which is not acceptable for product shots, since the products have to be portrayed as close to what they really look like as possible. There are cases when wide angle lenses are used in product shots, usually due to a different kind of expression they give in the shots. [1,13]

Lenses with fixed focal lengths can also be used within the same range of focal distances, though zoom lenses give more flexibility and the photographer does not have to move a tripod with a camera for every new composition. Lenses with wide apertures are often better for product shots, because of a possibility to focus on a subject and isolate it from the background. It is always recommended to use a lens hood in a studio, which prevents stray light from the flashes influencing the shots. [1,13]

#### Lighting setup

There are different ways to arrange lights and choosing one way or another depends on the qualities of the product being photographed as well as the overall atmosphere needed in the photograph. Nevertheless, there are certain principles of light composition for product and still life photography.

There is always one main light used to light the scene, that is also called **key light**. That is the light that casts shadows. In case of outside photography in natural light, key light is the sun. In a studio a photographer can control where the main light comes from. **Fill light** is the light that softens the shadows cast by the key light. Fill light should be weaker than key light, it does not even have to be a separate light source, it can be a surface that reflects main light. Many still life photographers also use effect lighting, which helps to illuminate separate parts of the scene in order to draw viewer's attention to that part or add to viewer's perception of the shape of the subject being lit.

In addition to these types of lighting, background lighting can be used to illuminate the backdrop. [1,58]

The relationship between key light and fill light affects the contrast of the scene photographed. When fill light is much less bright than key light, the shadows are much more visible and therefore there is a higher contrast in the photograph. When fill light is almost as bright as key light, the shadows are not so visible and the contrast appears to be lower. The intensity of the lights can be controlled from the settings of the flash units and well as by placing them closer or further away from the scene. Altering the contrast by changing the relationship between these two light sources can add to the style and atmosphere of the photographs. [5,100]

There are several ways to set up the light sources in a studio in order to achieve the desirable effect. Figure 1 demonstrates some of the common setups.

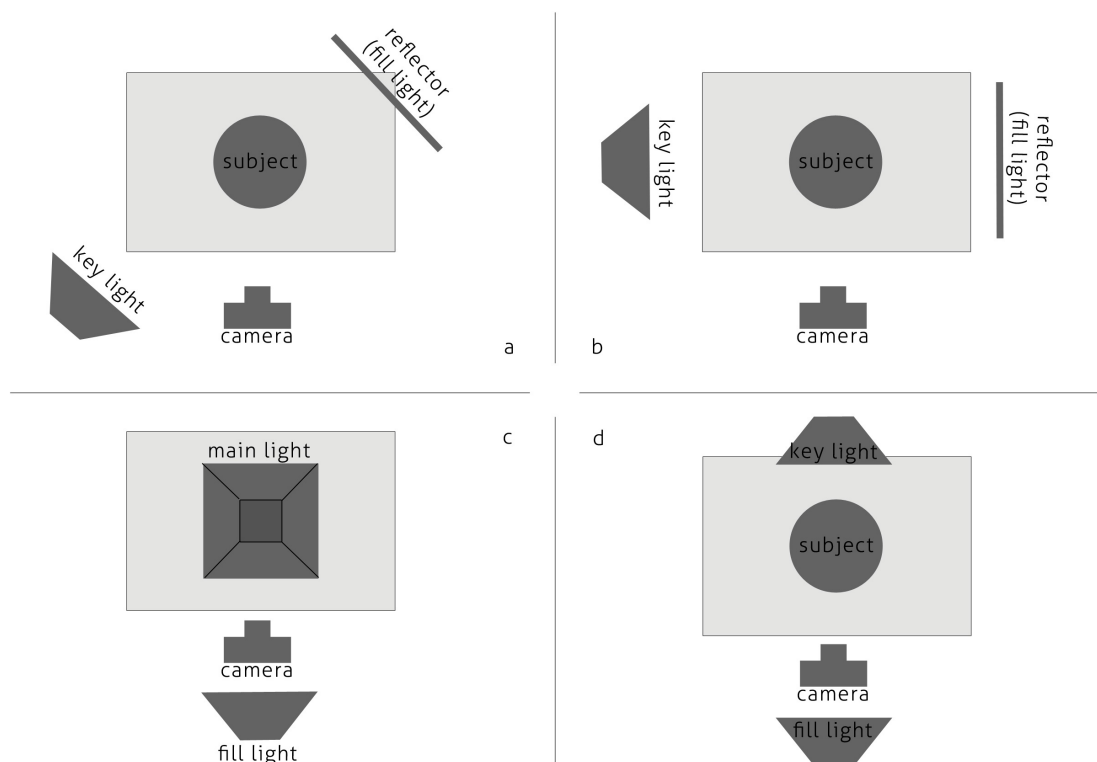


Figure 1. Common lighting setups

The most common way is to place the key light at 45 degree angle from the camera-subject axis and use fill light to brighten up the shadows (Figure 1a). The fill light is usually placed on the opposite side of the key light. In that case it does not have to be a separate light source, but can also be a reflector, because fill light should be less

powerful so that the shadows are still visible. Key light is usually placed slightly higher than the subject. This type of lighting looks more natural because the light falls similar to sunlight. It is also quite common to use this setup turned around. In those cases the key light is placed on the back and the fill light stays opposite to it, both still placed at 45 degree angle from the camera-subject axis. This is more common in portrait photography, though can be used for photographing some types of products. [5,98]

When key light is placed at 90 degree angle from the camera-subject axis (Figure 1b), it is referred to as sidelight [5,98]. Sidelight illuminates only one side of a subject but at the same time it brings out texture better than other light placement [1,60-61]. In some cases sidelight can be used on its own for more contrast and dramatic effect. Fill light can be placed on the opposite side or moved slightly to the front to brighten up the shadows. [5,98-103]

Lighting from the top (Figure 1c) is less common. It can create a different type of shadows and well as divide the subject into highlight and shadow areas. The shadows should be brightened up with fill light placed in front of the subject. In cases where fill light is strong enough, this type of lighting setup can be useful for creating the shots with a lot of light and as little shadows as possible. [1,60-61]

Lighting from the back of the subject (Figure 1d), also called backlight, can be used to emphasize the shape of the subject or its edges. Without any fill light it will give a silhouette effect. With fill light in front of the subject, this type of lighting setup is often used in situations where the subject needs to be separated from the background. [1,60-61]

### **Lighting equipment**

The most commonly used source of light in a studio is a studio flash unit, also referred to as studio strobe light. Studio flashes produce neutral white light that is much more powerful than that of continuous light sources. [6,46] Strobes produce very harsh light on their own, creating very clear shadows [1,32]. That is why various light shaping accessories are used to alter the light coming from the flash units to achieve the desired lighting effects. In small product photography studios compact shoe-mount flash units can also be used. Many light shaping tools are available for this type of flashes as well. One of their main disadvantages is that they do not have a modeling light, that helps the photographer to see light and shadow areas in the scene before firing the flash. [1,11-12]

**Soft boxes** are the most common light shaping tools used in a studio (Figure 2a). Soft boxes are collapsible fabric boxes with square or rectangular shaped front and a round frame that can be attached to the flash unit on the back. They are covered with aluminum textured surface on the inside that reflects all the light coming from the strobe. The front is covered with white fabric that diffuses light. Soft boxes produce very soft light that casts much softer shadows than plain strobe light. [6,49;1,35] In addition, the light coming from a soft box is so-called “wrap-around” light, that is not aimed very clearly, but goes everywhere where the soft box is pointed, leaving no areas with no light at all. There are also special kinds of soft boxes available, for example, strip lights, which are more tall rectangular soft boxes. Strip lights are used when a more narrow area should be lit. They are easier to aim than square soft boxes, and therefore are good in situations when the background or some other part of the composition does not need any lighting at all. [5,109] Octagonal shaped soft boxes are also available, but are mostly used for portrait photography due to the shape of the reflection they create in subject’s eyes [1,25].

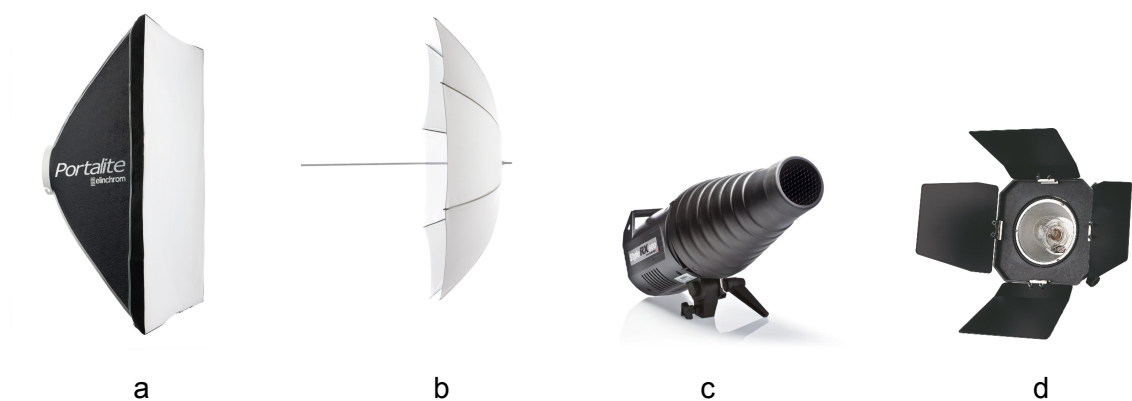


Figure 2. Light shaping accessories [7;8;9;10]

**Umbrellas** are also used a lot in studios to shape the light coming from the studio flashes (Figure 2b). They are mostly used for spreading the light and therefore making it less direct and more diffused. Umbrellas come in white, silver and gold colors. White umbrellas make the light softer, silver umbrellas make it more bright and gold ones produce more warm light. A strobe is usually directed towards the center inside the umbrella and the light bounces back onto the subject, but it is also possible to light the scene through an umbrella in case when it is transparent enough. Umbrellas are more flexible than soft boxes in a way that the distance between the flash unit and the reflective surface can be adjusted and the light can be aimed more easily. Umbrellas are also easily foldable and therefore easy to transport. [5,104-105] On the other hand,

the light shaped by an umbrella is more harsh than that of a soft box and is not always suitable for product photography, especially if gold or silver umbrellas are used [1,27].

One simple way to have an extra light source when there are no extra flashes is using a **reflector**. Basically any surface that bounces light can be a reflector, but it is preferable that the surface is slightly textured, so that the light it reflects is diffused. Professional reflectors (Figure 3a) are made of special fabric and come in white, silver and gold. These reflector colors work similarly to umbrellas, described above. Professional reflectors are usually collapsible and come in sets of different colors. Reflectors can be used as fill light when placed opposite to the key light. They can also be used to add some light in situations when key light, fill light and effect lighting are all placed in the scene, but some areas still lack lighting. [1,28;5,103;6,49]



Figure 3. Reflectors [11;12]

There is also another type of reflectors available: metal reflectors that are attached to the front of studio flashes (Figure 3b). Reflectors of this type bounce harsh light from the flashes making it easier to aim the light. These are not usually used in product photography due to hard shadows the produce, unless a lot of contrast is needed in the scene. [6,49]

Other special lighting tools, such as **snoots** (Figure 2c) and **barn doors** (Figure 2d) are used to illuminate certain parts of the scene. Snoots are very narrow reflectors that let the photographer focus on a small area. They are often used with color filters or honeycomb filters to add special effects. Barn doors have metal flaps that can be used to widen or narrow down the area that is lit. Various filters can also be used with barn doors for special effect lighting. [1,26-35]



## Table and backdrop

A proper table is also an essential part of product photography studio setup. For a stationary studio almost any table can be used as long as it has enough space for the type of products being photographed. It is also important that the table's height is suitable both for flash placement as well as camera and tripod placement so that it is comfortable for the photographer to do the necessary adjustments. Figure 4 demonstrates an example of a stationary product photography studio.



Figure 4. Product photography studio [13]

Depending on a type of photography, one or several backdrops are needed for neutral and even background. In most cases a roll of paper secured to the wall works as a backdrop (Figure 4). Piece of carton or plastic can also be used when attached to the wall with one side and clamped to the front edge of the table with the other side. When a roll is used it is useful to attach it to the wall so that its height can be adjusted. That way the setup can be used for photographing objects of different size. [1,44-46] In the example studio shown on Figure 4 the paper roll is placed on a wooden rod and secured to the ceiling of the studio with steel wire the length of which is adjustable [13].

There are also portable studio solutions available specifically designed for product photography. Portable photo tables are easy to transport, they are often collapsible and lightweight. A standard photo table is made of a metal frame and a plastic surface plate that can be removed and transported separately. Figure 5a demonstrates an example of a simple photo table. The more professional models are larger and more flexible.

Photo tables can usually be lit from above as well as from below the table. Combined with a set of portable lights, light stands and soft boxes, it can be a good solution for a portable product photography studio that gives professional looking results. [1,40-41]



Figure 5. Photo table and light box [14;15]

Even cheaper solution for a portable product photography studio is a light box (Figure 5b). Light boxes are lightweight and collapsible and they come in many different sizes. With this setup, a scene can be lit from outside the light box. In this case the walls of the box work as diffusers, therefore no soft boxes are needed. This setup is not as flexible as a professional studio and might not work with complicated compositions or special products, but is it quite good as a cheap solution for simple product shots. [3]

## 2.2 Editing

Even with good lighting and correct camera settings some colors in the photographs may still come out different from what the photographer wants them to be. That is when the images need to be edited using special software. Adobe Photoshop CS5 as a part of Adobe Creative Suite was used for this project for editing the photographs, therefore it is the only image editing tool that will be discussed here. There are two possible workflows for handling digital photographs and the appropriate one should be decided upon before the photographs are taken. The more advanced option is using RAW data from the camera to edit the images and converting it to image files using special software. The faster option is having the camera convert the data to image files

(usually JPEG or TIFF) on the go and using those ready files for the necessary editing. One of these options should be selected from the camera settings although some of the new cameras are capable of saving both types of files at the same time. [16,22]

When using RAW data format, the photographer gets to use all the information that the camera sensor receives when an image is captured and edit the image without losing any details [17,126]. The settings that have to be taken care of when shooting are focus, ISO and exposure (though exposure can be fine-tuned later with the software). Other settings such as white balance and color space can be taken care of later using special software. Since RAW data files are not image files they require special software for editing and converting them to image files. Camera Raw plug-in for Adobe Photoshop is an example of such software (Figure 6). [16,22-28]

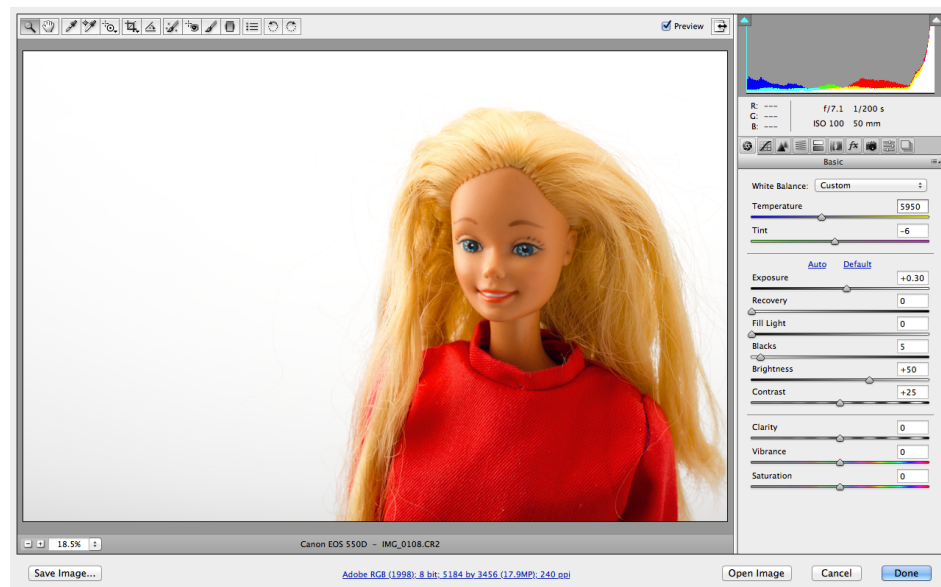


Figure 6. Adobe Camera Raw

Adobe Camera Raw can be used to perform a wide variety of tone and color correction tasks. The first tab in the Camera Raw window shown in Figure 6 includes some basic settings such as white balance adjustments, fine-tuning the exposure, recovery of over-exposed areas, adding or removing contrast, brightness, saturation and others. Other tabs feature more advanced settings such as tonal curve adjustments, sharpening, lens correction and camera calibration options. All of the settings can be saved and applied to other images shot in the same lighting conditions. Clicking “Open” (Figure 6) will convert the RAW data into an image file and open it in Photoshop, where further editing can be done if necessary. Batch processing and batch conversion of RAW files into image files are also possible with Adobe Bridge, which is an advanced file browser software within the Adobe Creative Suite CS5. [17,126-131]

When the camera is set to save image files it uses its built-in mechanisms to convert RAW data from its sensor into JPEG or TIFF files. The conversions are performed taking into account such settings as white balance, color space, sharpening and other color adjustments set by the user or camera manufacturer. The output files from the camera are ready to be viewed or edited in a software like Photoshop without any prior conversions, that is why this workflow requires much less time spent before the images are ready to be used. On the other hand, the user does not have any control over the conversion of RAW data into an image file and the output files have much less data to work with. When the result of the conversion is not acceptable, editing needs to be done which might result in some loss of detail in the final image. [16,22]

When ready JPEG or TIFF files are imported from a camera, they might need some color adjustments that can be done in Photoshop. Images converted from RAW data might need some of those adjustments too. There are several techniques in Photoshop that allow color correction. For all of those techniques it is recommended to use adjustment layers instead of applying them to the image itself. Adjustment layers allow the user to keep the changes on a separate layer without changing the initial image. This type of adjustments can be easily removed by deleting the adjustment layers or edited further with no change done to the original image pixels. [17,142] Figure 7 demonstrates some of the most commonly used adjustment layers in Photoshop CS5.

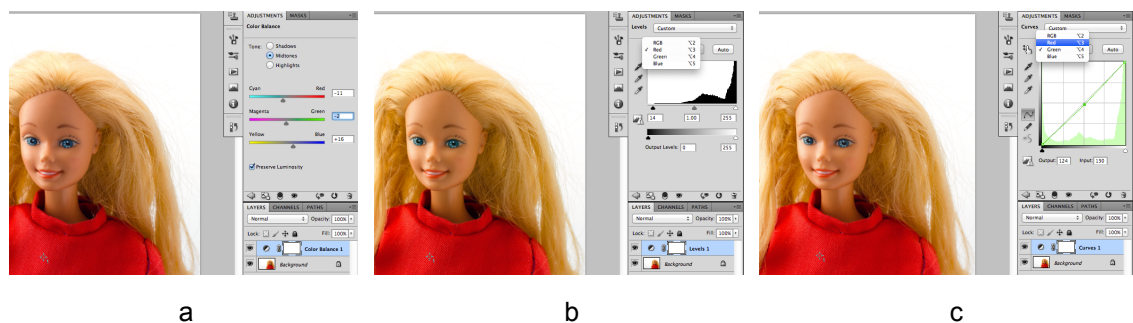


Figure 7. Color correction with adjustment layers in Adobe Photoshop CS5

The “Color Balance” adjustment (Figure 7a) includes three sliders with the primary colors on each side. The user can move the sliders towards one of each colors shifting all the colors in the image towards that color. This process can be done separately for shadows, highlights and midtones by selecting them from the list above the sliders. Selecting the “Preserve Luminosity” checkbox allows the user to keep the lightness of the whole image constant while keeping it unchecked might lead to the whole image getting lighter or darker as a result of shifting it towards one or another color. [17,142-143]

The “Levels” adjustment control (Figure 7b) includes a histogram that demonstrates tonal information of the whole image as well as for each of the primary colors, which can be selected from the drop down list. Moving the black, white and gray sliders will adjust the colors in shadow, highlight and midtone areas respectively. When RGB is selected from the drop down list, the lightness of all the colors in the image can be adjusted, while selecting each of the primary colors will enable a user to add or remove the selected color. Another adjustment available within the “Levels” control section is the “Color Picker” tool. There are three color pickers available: black, white and gray. When the user selects the darkest area in the image with the black color picker, the lightest with the white one and the area that should be neutral with the gray color picker Photoshop automatically adjusts all the colors in an image accordingly. [17,144-145]

The “Curves” adjustment control (Figure 7c) is a more advanced tool for color correction in Photoshop. Similarly to “Levels”, there are curves available for overall tonal adjustment as well as for each of the primary colors that can be selected from the drop down list. What makes it more advanced and therefore more precise is that there is a possibility to place an anchor point anywhere on the curve instead of just selecting shadow, highlight or midtone areas. There can be several anchor points on each curve and moving them up or down will adjust the selected primary color in the appropriate tonal range of the image. To find out where an anchor point needs to be placed the user can use the “hand” button to the left from the drop down list. When that button is pressed the mouse can be moved around the image and a small circle will show the area on the curve where the adjustment needs to be made in order to affect that area. When the mouse is pressed in the desirable area and moved up or down the anchor point is created automatically and the color is adjusted at that point. The “Color Picker” tool is available within the “Curves” control as well as in “Levels” and it works the same way. [17,146-147]

All the techniques mentioned above involve analyzing the colors in the images visually. This type of assessment is useful in many cases but is subjective to the viewer and can be influenced by display calibration or lighting temperature in the room. Another way to assess color adjustments is to look at the RGB numbers in certain areas and adjust according to them. Figure 8 demonstrates an example of using this technique. To make this adjustment a color sampler needs to be placed in an area that is known, for example, for being neutral. In the image shown in Figure 8 it is placed in bottom right corner. When the color sampler is placed using the “Color Sampler Tool” (available from the “Tools” panel) the Info palette (available from the “Window” menu) will show the RGB numbers for the color in the area where the sampler is placed.

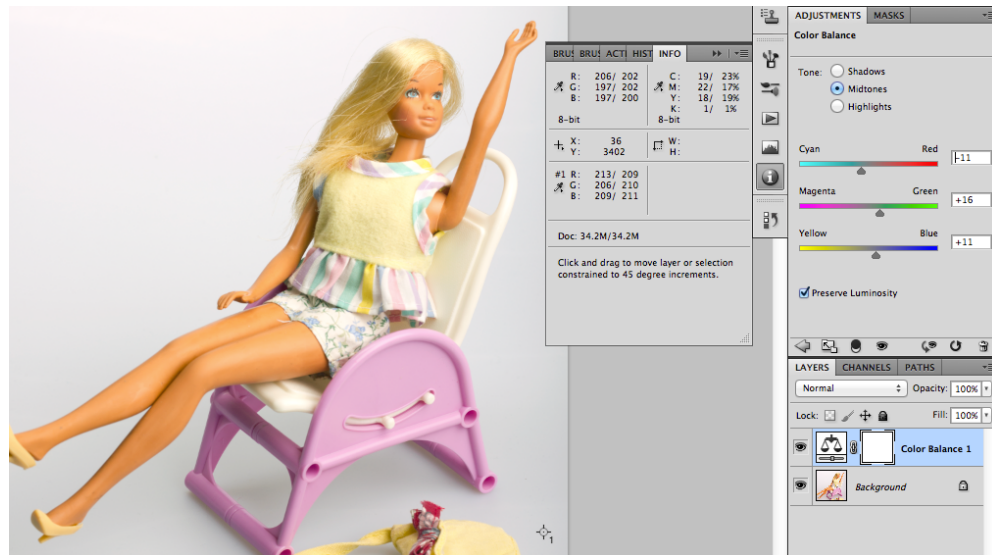


Figure 8. Using “Color Sampler Tool” and “Info” palette for color correction

There can be up to 4 color samplers placed onto one image and they are numbered #1, #2, etc. Any of the color correction techniques mentioned above can be used to adjust the colors until the numbers are correct. [17,148-150] In the example demonstrated in Figure 8 there are areas where the colors need to be neutral, which means the RGB numbers need to all be the same to achieve neutral gray. The “Color Balance” adjustment layer is created and the sliders are adjusted until the RGB numbers are all the same.

There are cases, where colors need to be adjusted in one area of an image rather than in the whole image. There are a couple of techniques available in Photoshop for selective color correction. Figure 9 demonstrates those techniques.

“Selective Color” adjustment control (Figure 9a) can be applied to an image as an adjustment layer. It enables a user to adjust each of the colors in an image separately. The color can be selected from the drop down list. For each of the available colors there are four sliders with each of the CMYK primary colors. Moving those sliders will only affect the color selected from the drop down list. In the example in Figure 9a, some yellow is removed from all areas that contain red in the image, which is mainly the doll’s dress. [17,151-157]



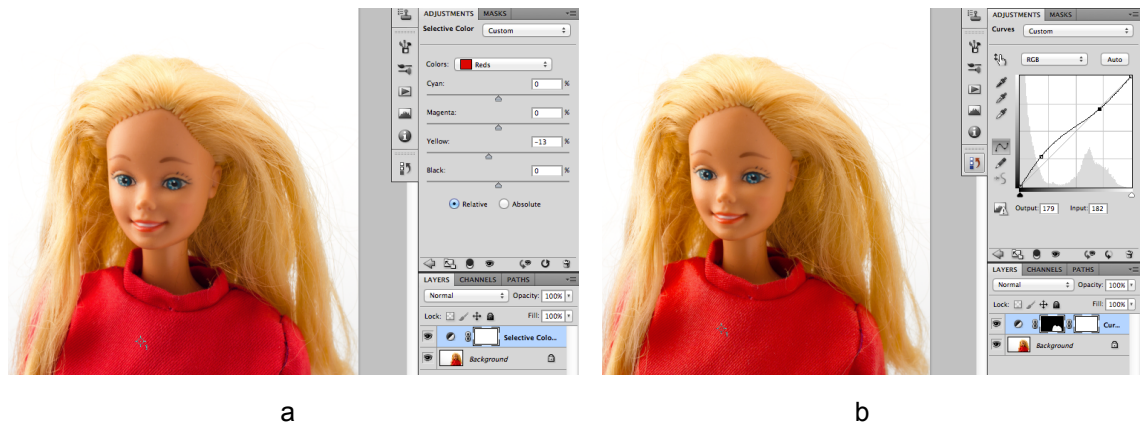


Figure 9. Selective Color and Layer Mask

Using a layer mask is another way to have the color correction only in certain areas of the image. To use this technique, any type of adjustment layer described above should be created and adjustments should be made as if they would affect only the desired area. Then a layer mask should be applied by pressing the button on the small panel below the layers. A mask icon appears next to the name of the adjustment layer (Figure 9b). Keeping that icon selected, the user needs to paint the image using white for the areas that need to be affected by the adjustment and black for the areas that need to stay as they were before the adjustment layer was created. All shades of gray in between can also be used for different levels of the mask effect. Selections, brushes, bucket tool and any other tools that allow painting in Photoshop can be used for creating the layer mask. [17,151-157] In the example in Figure 9b a layer mask was created on a “Curves” adjustment layer to color correct only the red color of the doll’s dress. The whole image was filled with black and the red area was painted white.

## 2.3 Color management

### 2.3.1 Profiles

In product photography it is very important to keep the color consistency in order for the end client to see the products in a web shop or in a catalog the same way they appear in reality. Correct lighting plays a big role in capturing the right colors, but it is also important to keep those colors the same throughout the whole process from capturing until printing or uploading on the web. There are several steps in this production process and different steps involve different software and devices. Switching between them may require conversions, that may change the color appearance of the images. Using color management tools and techniques throughout

the process helps to keep those conversions under control and therefore insure the color consistency of the images.

ICC profiles are the most important components of a color management system. [17,14] Most of color management processes are performed to either create profiles or convert them from one to another. That is why it is important to understand what ICC profiles are before describing the processes of the color management workflow.

Each device used in digital photography workflow reproduces colors differently. Cameras and monitors use RGB color model while printers use CMYK. Both of those color models are called “device-specific”, because every device has its own way of interpreting the RGB and CMYK numbers. These color models do not describe colors, instead they only send signals to devices in order for them to execute certain color behavior. The same set of numbers will give different color representation when presented on two different devices. Not only different models of a device vary in their color representation, but also each device of the same model produced at the same time might still show slightly different color behavior. Printers’ color values may also vary depending on the type of paper used. [18,67,79]

Device-independent color models, such as CIE XYZ, CIELAB as well as many others are designed to describe the colors based on the way human eyes perceive them. Each set of numbers in such color model describes an exact color. This model cannot be used to send signals to devices in order to produce that exact color. Instead, it can be used to assess the colors the device produces. Therefore, both device-dependent and device-independent color models need to be used within a color management system. Such system uses device-independent models to assess the colors reproduced by a device that is given a certain RGB or CMYK input and adjusts that input to produce desirable result. [18,69,80]

Device profiles are created as separate files that describe device behavior. They match the output RGB and CMYK values of the device with the corresponding CIELAB values, which stand for the colors human eyes perceive. Profiles also contain information about the gamut of the device as well as its dynamic range. There are three types of device profiles: input profiles for cameras and scanners, display profiles and output profiles for printers. When applied to a device, profiles enable it to represent correct colors. [18,100]



There are also profiles that can be embedded within an image. This means that a profile is saved as part of an image file. Those profiles do not change the color numbers of an image. Instead, they allow any ICC-aware application to interpret those numbers correctly. Images with no embedded profiles, also called untagged, do not have any information on how their color numbers should be read. Assigning different profiles to them may give different color appearance without changing their color information. [19,38] That is why it is important to always tag images with appropriate profiles within a color managed workflow in order for the colors to be correctly displayed on each of the next steps.

### **2.3.2 Camera profiling**

In digital product photography camera is the first device in the pipeline that works with digital images. Similarly to other devices, different cameras interpret the RGB input they receive differently which means they need profiling. Good lighting, control over white balance and RAW workflow (all discussed in previous chapters) are very important in keeping the color consistency when capturing an image. However, custom camera profiles allow even more control over the camera's own color representation. One feature that makes it harder to make profiles for cameras than other devices is that cameras often work in variable lighting situations. In natural conditions light changes all the time depending on the weather as well as the time of day. In those cases a profile would not work well anymore once the lighting has changed. Therefore, camera profiles work best in controlled lighting conditions such as a studio lighting environment. [17,119-120]

Creating camera profiles is only useful when working with a RAW workflow. When shooting in JPEG the camera renders images into a certain RGB workspace. Some cameras allow users to select between two or more different RGB workspaces while others have only one standard workspace. Some cameras assign a corresponding profile to images they produce while others leave the images untagged. In all those cases the camera takes care of color management and the user is left with ready images which can be color corrected using image editing software in case the color representation is not appropriate. When working with RAW data the user has a possibility to apply a custom camera profile to the images as well as tag them with a preferred RGB profile when converting to JPEG or other image file format. [19,164-168]

Camera profiles are created using special profiling targets that contain a set of standard colors. Figure 10 demonstrates some examples of camera profiling targets.



Figure 10. Camera profiling targets [20]

When the studio lighting setup is ready and works well a target needs to be placed into the setting so that all of its color patches are evenly lit. Then a photograph of the target should be taken after which the subjects can be placed in the setting and photographed as planned. When the lighting setup needs to be changed, the target should be photographed again in the new setup before the photographs of the subjects are taken. Before editing the product photographs, the target photographs should be imported into special profiling software that is compatible with the target used. A software of this type will create a profile using the target image. A separate profile should be created for each lighting setup used in the session and appropriate titles should be given to each of these profiles. [17,120-121] The profiles can be applied to the images within a RAW converter software [19,176].

### 2.3.3 Display calibration and profiling

Display calibration and profiling is another key step of color management. After the photographs are captured with digital camera, they are opened and edited with special software and all the time display is used to visually assess them. Therefore, when the display does not show the correct colors, the photographer cannot be sure whether his or her edits do what he or she intends them to do. That is why displays should always be calibrated and profiled. There are various software and hardware tools that can be used to calibrate and profile a display. Most of the packages do both calibration and profiling in one process.

Calibration is the first step, during which a set of standard colors is displayed by a special software and measured by a special hardware device after which the software adjusts the display's colors to the factory standards. This step is necessary because displays are unstable devices and their color behavior may change over time.

Afterwards another set of colors is displayed and measured by a hardware device. This process is done in order to analyze the behavior of the display and create an ICC profile for it. That process is called profiling. [19,117-120]

There are two types of devices that are used to measure color patches displayed during the display calibration and profiling process [19,124]. They are called spectrophotometers and colorimeters. These devices are discussed and demonstrated below in the “Printer profiling” subchapter.

There are several settings that need to be considered when calibrating a display, such as a tonal response curve, white point and luminance. All of these controls need to be set within the calibration software before starting the calibration. The tonal response curve, also referred to as gamma, is recommended to be set to 2.2 in most of the cases. The most commonly used values for white point are D50 and D65. D50 is mostly used for graphic arts and offset printing while D65 is recommended to use for photography. The luminance of display’s white is often set at 150 cd/m<sup>2</sup> (candelas per square meter) in LCD display, though this number often depends on the display capabilities. When using more than one display within the color managed workflow it is very important to keep the display luminance as well as other calibration settings the same in all of the displays used. [19,120-122]

#### **2.3.4 Color management in Adobe Photoshop**

Another important step in product photography production workflow is image editing that takes place in image editing software. Since Adobe Photoshop CS5 is the only image editing software used in this project the color management techniques within this application will be discussed. Color management happens in Photoshop whether the user is aware of it or not [19,62]. To keep control over color consistency along the whole production workflow the user needs to take into account Photoshop’s color management techniques.

##### **Color settings**

The Color Settings dialog (Figure 11) in Photoshop CS5 can be found in Edit - Color Settings menu. It is the main place for setting color management controls in Photoshop. The first drop-down menu of the dialog is called “Settings” and it contains different color setting presets. Selecting one of the options in this menu will change values to all the settings in this dialog. These presets are saved within the application

by the manufacturer. A user can use the available presets or change the settings of the dialog to the preferred values and save them as a custom preset in order to easily access them later. [19,63-64]

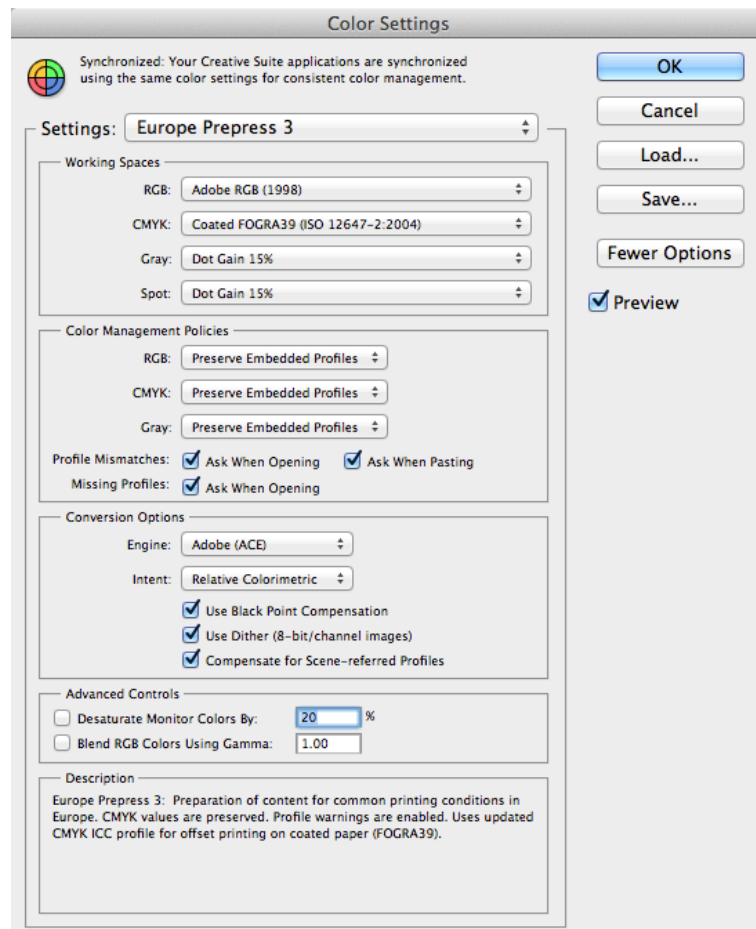
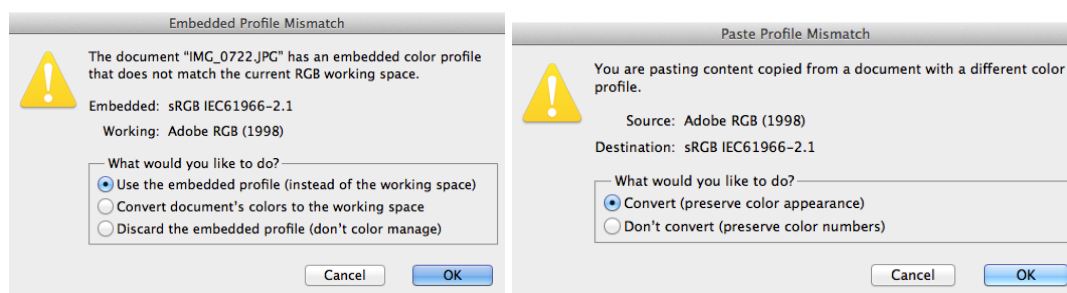


Figure 11. Photoshop Color Settings

Photoshop Color Settings dialog is broken up into four sections: Working Spaces, Color Management Policies, Conversion Options and Advanced Controls (Figure 11). “Working Spaces” section allows a user to select preferable working spaces for RGB and CMYK files as well as grayscale and spot colors. All new files created in Photoshop have a default embedded profile corresponding to the working space selected, new RAW files are tagged with that profile as well as untagged images are handled as if they were tagged with that profile. Whenever an image with a different embedded profile is imported to Photoshop, a dialog appears asking whether the profile should be converted to that of a chosen working space or kept as it is. [19,66]

“Color Management Policies” section allows a user to decide how Photoshop behaves when an opened image has a different profile from that of a selected working space or when an image is pasted onto another image with a different embedded profile. The

three drop-downs (Figure 11) let the user select whether embedded profiles should be preserved or converted to the current working space. Three check boxes below allow the user to decide whether Photoshop should notify her/him about mismatched or missing profiles. [19,75-77] Figure 12 shows the dialogs that appear when an image with a mismatched color profile is opened or pasted in Adobe Photoshop CS5.



a

b

Figure 12. Profile Mismatch dialogs in Adobe Photoshop CS5

When a document with a mismatched embedded profile is opened, a dialog appears suggesting a user three options: using the embedded profile, converting it to the working space profile or discarding it (Figure 12a). The last option is usually not preferable, because it does not let the user control the colors in the image and breaks up color consistency. An untagged image may show differently when opened on another computer and another user will not know which profile it should be tagged with. In most cases either of the first two options should be selected depending on which profile needs to be used in this particular situation. [19,78-79]

When an image is pasted on top of another image with a different color profile, Photoshop suggests two options: convert (preserve color appearance) or don't convert (preserve color numbers) (Figure 12b). Selecting the first option will let the user convert the source file's profile to the destination file's profile, meaning that the numbers will be changed in order to keep the same color appearance as in the source file. The second option lets the user preserve the numbers of the source file, which may result in different color appearance when pasted onto the destination file. The reason for that is that a different profile may interpret the numbers differently. In most cases the source profile is converted to the destination profile, because usually the user would prefer to preserve initial colors. The second option is mostly used for profile testing purposes. [19,81]

When a "More Options" button on the right side of the Color Settings dialog is pressed a user can see two advanced sections in addition to the the basic ones. The advanced

sections are “Conversion Options” and “Advanced Controls” (Figure 11). The “Conversion Options” section provides settings for color space conversions. Those conversions are done by selecting the “Image-Mode” command in Photoshop. That can be, for example, converting an RGB image into CMYK using “Image-Mode-CMYK” command. The settings of “Convert to Profile” command are not affected by the “Conversion Options”.

The first two drop-down menus let the user select an engine and a rendering intent to be used for conversion. When “Use Black Point Compensation” check box is selected it tells the conversion mechanism to ignore the luminance of black and match the darkest black of the source with the darkest black of the output. That way there is no risk that the black color of the conversion output would be too light which could lead to the print lacking contrast. The “Use Dither” checkbox prevents aliasing when converting 8-bit per color images. [19,83-84]

The last section of Adobe Photoshop’s Color Settings dialog is called “Advanced Controls” (Figure 11). The first checkbox in the section allows a user to desaturate monitor colors by a chosen percentage. This checkbox is usually recommended to be left unchecked unless the user is very experienced in working with large gamut working spaces. The setting is usually used when the working space’s gamut is larger than that of a monitor resulting in the monitor being unable to display some of the colors in the working space. Desaturating the colors with the right percentage makes them fit into monitor’s gamut which helps the user handle those colors. [17,36-37]

The second checkbox that says “Blend RGB Colors Using Gamma” is also recommended to be left unchecked when working with digital photography. In default condition, when the option is unchecked, Photoshop blends colors in similar ways as they blend in printing. When colors are mixed, a resulting color is usually a darker version of the top color with a blend of the bottom one. When the checkbox is checked Photoshop will blend colors similarly to how light behaves (a new lighter color as a result of two colors mixed). [17,36-37]

### **Converting and assigning profiles**

When an opened image is missing a profile or is tagged with an incorrect profile a proper profile can be assigned using the “Edit - Assign Profile” command. This command does not change any of the color information inside the image file. Assigning a correct profile to a image lets Photoshop interpret the numbers within an image file

properly. There are situations when a user knows which profile should be assigned, other times he/she needs to guess which profile is correct. For that to be done the “Preview” checkbox in the “Assign Profile” dialog should be checked while different profiles from the drop-down menu are selected one by one and the image is assessed visually. [19,86-87]

Figure 13 shows different profiles selected to be assigned to an untagged image. It is clearly seen that different profiles interpret the image’s numbers differently and some colors appear to be lighter or darker, more or less saturated with some profiles than the others. In order to select a proper profile a user needs to decide which color appearance is correct for that particular image [19,86].

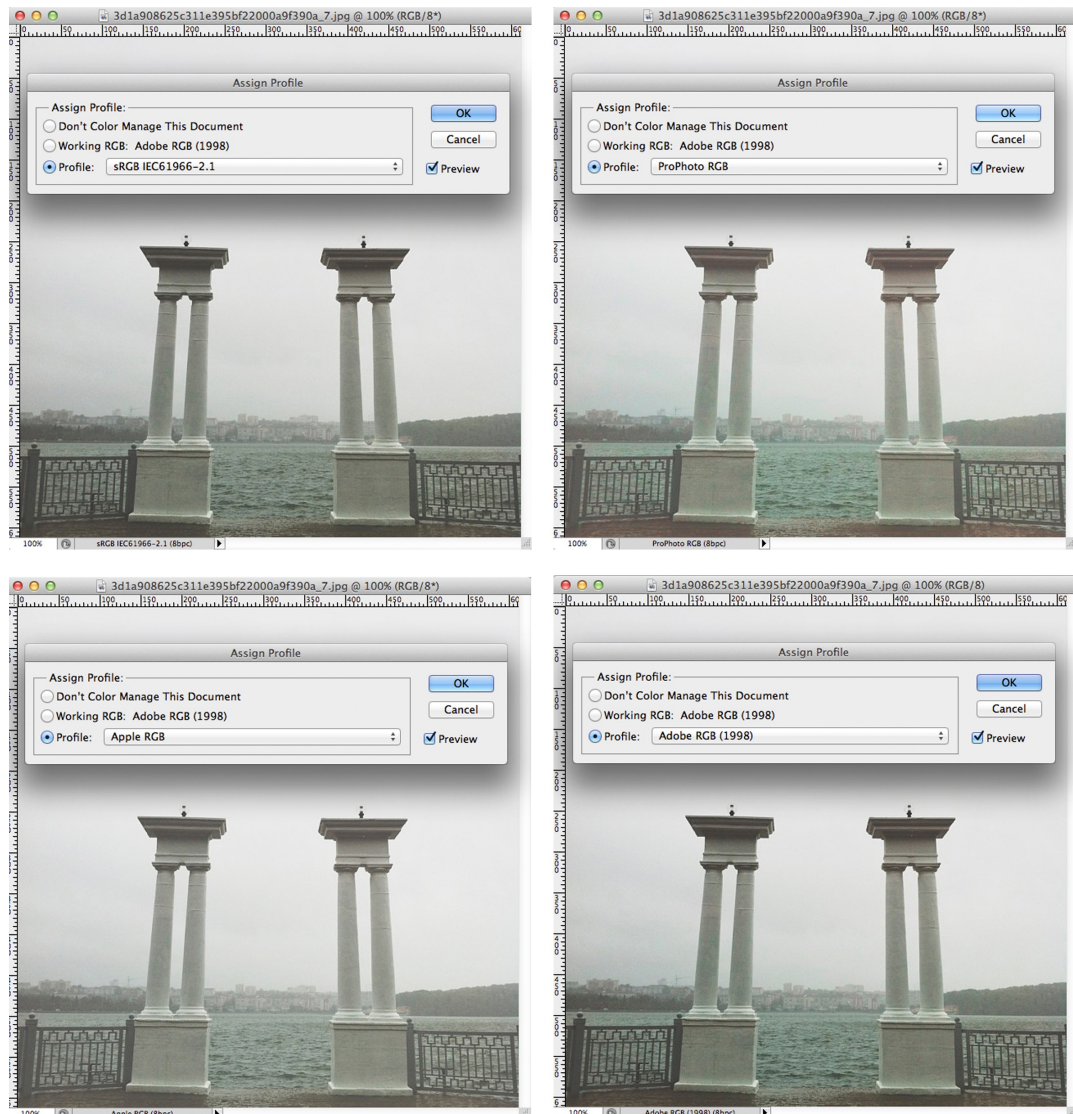


Figure 13. Assigning profiles in Adobe Photoshop



The same dialog (Figure 13) allows a user to untag an image, which means removing the embedded profile from the image file. Selecting “Don’t Color Manage This Document” will do that. Usually this step should not be done in a color managed workflow unless there is a reason for it. Untagging can be done in situations where the final file size needs to be small and no changes to the file are done after untagging it. [19,86-87]

“Convert to Profile” is another color management option available under the “Edit” menu in Photoshop. This command can be used whenever a profile conversion needs to be done. It can be either changing between different RGB working spaces or converting RGB into CMYK or Grayscale. This command does change the numbers within the image file simultaneously assigning a new profile to the image. [19,87] Figure 14 shows a dialog that appears when applying this command.

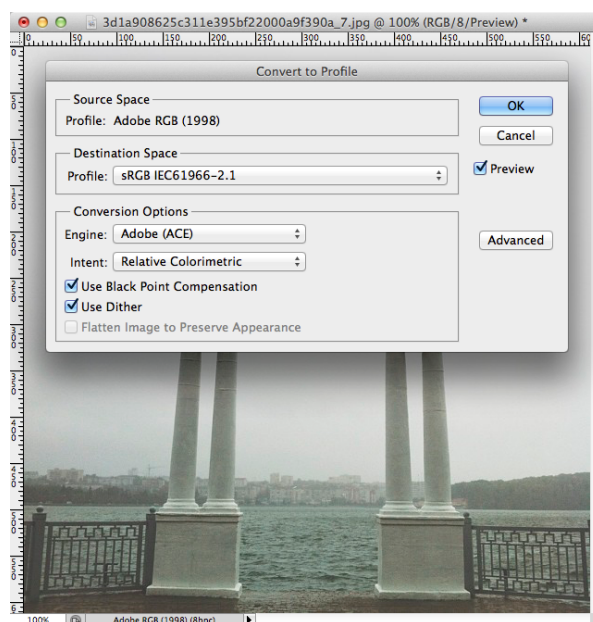


Figure 14. Converting to profile

There are a few options to choose from when converting an image to a different profile (Figure 14). The “Destination Space” section of the “Convert to Profile” dialog contains a drop down list with all the possible profiles the image can be converted to. The “Conversion Options” section offers some settings for the conversion. Those settings are similar to the ones found in the Photoshop’s “Color Settings” dialog described above. Profile conversions are needed when an incoming image has a different embedded profile than the one used in the production workflow. It may also be necessary when the next step of the workflow, e.g. printing the image, requires a different profile. Although, in many cases no conversions are required from a working



profile to a printer profile, because printer drivers are often capable of converting to output profiles themselves. In those situations it is only important to make sure that an image is tagged with a profile so that the printer driver knows which profile to convert from. [19,88-90]

### Soft proofing

Soft proofing is a mechanism in Adobe Photoshop that enables a user to preview an image as it would appear in print. This is necessary because images are usually edited in an RGB workspace, which is appropriate for viewing images on screen. CMYK workspaces (that are used by printers) have smaller gamut than the RGB ones. Therefore, RGB images lose some of the original colors when printed. When an output device is known or at least a profile for that device is available, soft proofing makes it possible for a user to see what the image would look like when converted to printer's CMYK. [19,90-91] The mechanism can be accessed from the "View" menu in Adobe Photoshop CS5. There are two commands for soft proofing: "Proof Setup" for specifying the output profile and "Proof Colors" for turning on the proof mode. Selecting "Proof Setup" gives several preset options to choose from as well as a "Custom" option. Selecting "Custom" opens a dialog called "Customize Proof Condition" demonstrated in Figure 15.

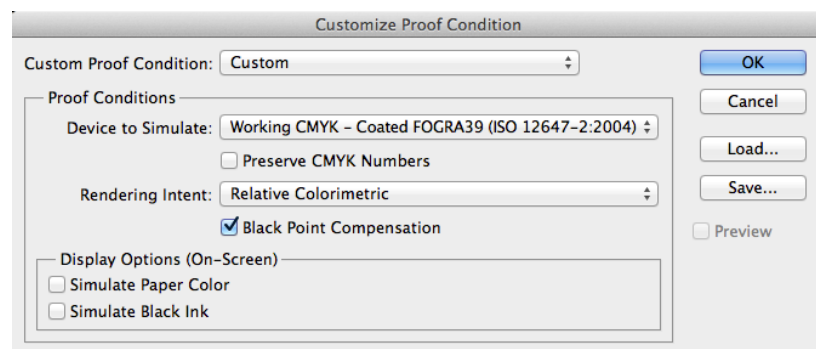


Figure 15. Customize Proof Condition

The "Customize Proof Condition" dialog (Figure 15) allows a user to select a custom profile ("Device to Simulate") for soft proof as well as some settings for simulation such as rendering intent and black point compensation. The "Preserve Numbers" checkbox allows a user to preview a print of an image without any conversion to an output profile. Selecting "Simulate Paper Color" and "Simulate Black Ink" checkboxes adjusts absolute black and absolute white colors to look more similar to the ones in print instead of the lightest white and the darkest black a display can produce. All these

settings can be saved as an external file and accessed later as well as shared with other users. [19,94-97]

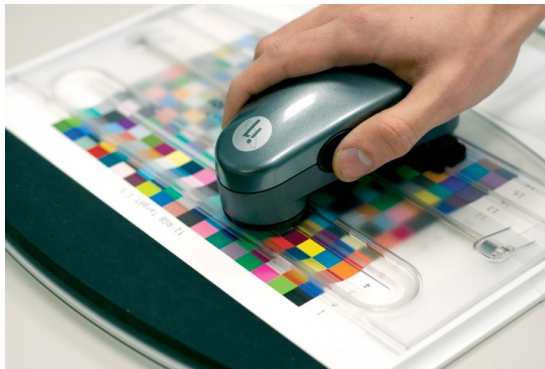
### **2.3.5 Printer profiles**

Building printer profiles is in many ways similar to profiling other output devices, such as monitors. The process also includes measuring a set of standard colors that a printer produces, comparing the output values with given values and creating a profile that describes printer behavior. What makes printer profiling more complicated is that printers often use more than one type of paper as well as more than one type of ink. Each type of ink or paper gives different color representation, which is why a single printer may need several profiles for different inks and papers. [17,172-173]

There are different ways a photographer can go with using printer profiles from generic profiles built by manufacturers to custom-built profiles for a specific machine. The simplest and fastest scenario is using manufacturer-built profiles. Those profiles are usually available within the software package that comes with a printer. They are built for a specific printer model and a type of ink that the printer can be used with. A package can include several profiles for different papers available for the chosen printer model. Third-party paper providers also supply generic profiles for printers that their papers can be used with. In many cases those profiles can give acceptable results, but they are not built for a specific machine, that is why they are not always accurate. When using manufacturer-built profiles it is advisable to keep an eye for profile updates in case there are changes in paper or ink production, which can influence the color representation. [17,184]

Building a custom profile for a specific printer is a more complicated process that takes time, but it enables a user to build more accurate profiles specifically for the machine used. This scenario is also more flexible in cases when new profiles need to be created for new papers or inks as well as when old profiles stop giving acceptable results. [17,174] Before creating a profile all the necessary maintenance operations, such as nozzle check, as well as calibration should be performed. This step insures the printer is behaving as it should according to factory specifications when the targets are printed. Some profiling software include an additional step before creating a profile that is called linearization. One or more linearization targets are printed with patches for each of the CMYK colors in many steps from lightest to darkest. Those targets are then measured and profiling targets are adjusted for creating a profile of higher accuracy.

Afterwards the profiling targets are printed out, measured and the measurements are then used by the software to create a profile. [19,186-199]



a



b

Figure 16. Spectrophotometer [21;22]

The devices used for measuring targets include spectrophotometers and colorimeters. Spectrophotometers are more common in professional settings as they produce more accurate results, while colorimeters are a more low-price solution. Spectrophotometers come in various different packages that may help reduce the time spent on measuring the targets, but can also be used on their own. Figure 16 demonstrates two examples of spectrophotometers and the package options: a scanning ruler (Figure 16a) that helps scanning target strips by hand and an automated scanning table (Figure 16b) that requires minimum human involvement and scans the targets even faster. [19,187-195]

### 2.3.6 Color management for web

When posting images on the web it is usually advised to convert them to sRGB. Different browsers have different ways of handling embedded profiles. Some browsers can take them into account, others ignore them. But most of the browsers have sRGB as their standard color space and when they see untagged images they assume they are in sRGB. [19,139-140]

Different users will view the images on different browsers, so it is not reasonable to adjust to only one browser's color management preference. That is why converting to sRGB before posting on the web is the safest option. An embedded profile can also be removed (by selecting "Don't Color Manage This Document" from the "Assign Profile" dialog) after converting to sRGB when an image needs to be of a smaller size in order to be uploaded on the web. [19,139-140]

### 3 Materials and methods

#### 3.1 Studio setup

A compact portable product photography studio setup was used for this project. For lighting the scene Elinchrom D-Lite RX To Go Set shown in Figure 17 was used. It is a portable flashlight set, that fits in two bags and can be transported and stored easily. The set includes two Elinchrom D-Lite RX flash units, two 66 cm softboxes and a Skyport transmitter for triggering the flashes, as well as flashlight stands, reflectors, umbrellas and special bags for storage and transportation.



Figure 17. Elinchrom D-Lite RX To Go Set [23]

The D-Lite RX flash units produce neutral light with color temperature of 5500k and feature a modeling light option that allows to preview the direction of the light and possible shadows before firing the flashes. [24] The Skyport transmitter is capable of triggering the flash units at sync speed up to 1/250 s in “Speed” mode and up to 1/160 - 1/1200 in “Standard” mode. The sync speed may vary in different environment conditions depending on interference with other electronic devices as well as reflections from the walls, ceilings, furniture etc. [25] In addition to flashes a white circular reflector was used as a lighting accessory.

A photo table similar to the one shown in Figure 5a was used to photograph the products on. The table surface was made of slightly translucent white plastic, that could also function as a diffuser allowing to light up the scene also from the back of the table. The whole setup was placed in a small room with no windows to avoid any uncontrolled light coming in.

There were several different lighting setups tested. As a starting point some of the basic setups demonstrated in Figure 1 were assembled. Figure 17 demonstrates the use of the most common way of lighting where the key light is placed at 45 degree angle to the right of the subject-camera axis and the fill light is placed opposite to the key light.



Figure 17. Lighting at a 45 degree angle

This lighting setup was tested using two flash units (Figure 17a) as well as one flash unit and a reflector (Figure 17b). The second flash unit seemed to smooth out the shadows more effectively, while the reflector left the shadows more visible giving the image more contrast. In both cases the subject was lit quite evenly, but the background was lacking some light.

Sidelight technique was also tested by placing the key light at 90 degree angle to the left of the subject-camera axis and the fill light opposite to the key light. Figure 18 shows the resulting image of using sidelight. In this setting the flash units were moved slightly towards the front of the subject to light the doll's face as well as the background more evenly. This lighting setup needed some tweaking before it could be used to evenly light the scene. The flashes were moved slightly to the front and back as well as closer and further away from the subject before a good position was found.



Figure 18. Sidelight

Sidelight seemed to provide better lighting for the background than the first setup tested (Figure 18). Both the background and the subject were lit evenly. On the other hand, the face of the doll looked too flat as there was almost no natural shadows. This type of lighting was also difficult to implement as moving the flash units away from the subject to both sides was not always possible in a small space environment.

When both of these lighting set ups were found to not provide enough light for the background, the backlight setup was tested. One of the flash units was placed behind the table without the soft box attached since the slightly transparent surface of the table could diffuse the light on its own. The second flash unit was used as a key light and a reflector was used as a fill light. Different positions for the key and fill lights were tried

and the backlight was also moved up and down. Figure 19 shows one result of those different backlight setups.



Figure 19. Backlight

All of the photographs shot with the use of backlight had a similar effect to the one shown in Figure 19. There was very bright lighting in the center of the backdrop, which gradually became much darker towards the edges of the image.

Lighting from the top was also tested and the results are demonstrated in Figure 20 below. The key light was placed above the subject and moved up and down until the lighting was even. The stand used for the flash unit did not allow placing it directly at the top, so it was placed slightly to the left. The fill light was placed in front of the subject and moved slightly to the right to compensate the shadows created by the key light. This setup created a different type of shadows on the doll's face and made it look more three-dimensional and natural than the sidelight. It also created more bright and even lighting on the background. When only two flash units were used a slightly distracting shadow appeared on the bottom-left of the doll's face (Figure 20a). To soften that shadow a reflector was held below the subject in the direction of that shadow (Figure 20b).





Figure 20. Lighting from the top

Another studio setup different from the standard ones was found to also give acceptable results. In this setup both of the lights were placed in front of the subject and a reflector was placed on the left side. The key light was directed at the subject and positioned at a 45 degree angle to the right from the subject-camera axis. The second light was placed higher than the key light, almost right in front of the subject, moved just slightly to the left and directed a little downwards. The purpose of this light was to light up the background. A white reflector was used as a fill light. It was hand-held opposite to the key light, which was to the left side of the subject and slightly to the back of the scene.

This type of lighting gave especially good close-up shots. The full-height shots looked acceptable as well, but the background was not always evenly lit. The flash unit that was lighting the background was mostly targeted towards the back of the table and as a result there was not enough light directed at the bottom. Figure 21 demonstrates the setup (the reflector is not shown, because it was hand-held) as well as one of the close-up photographs shot when using this setup.



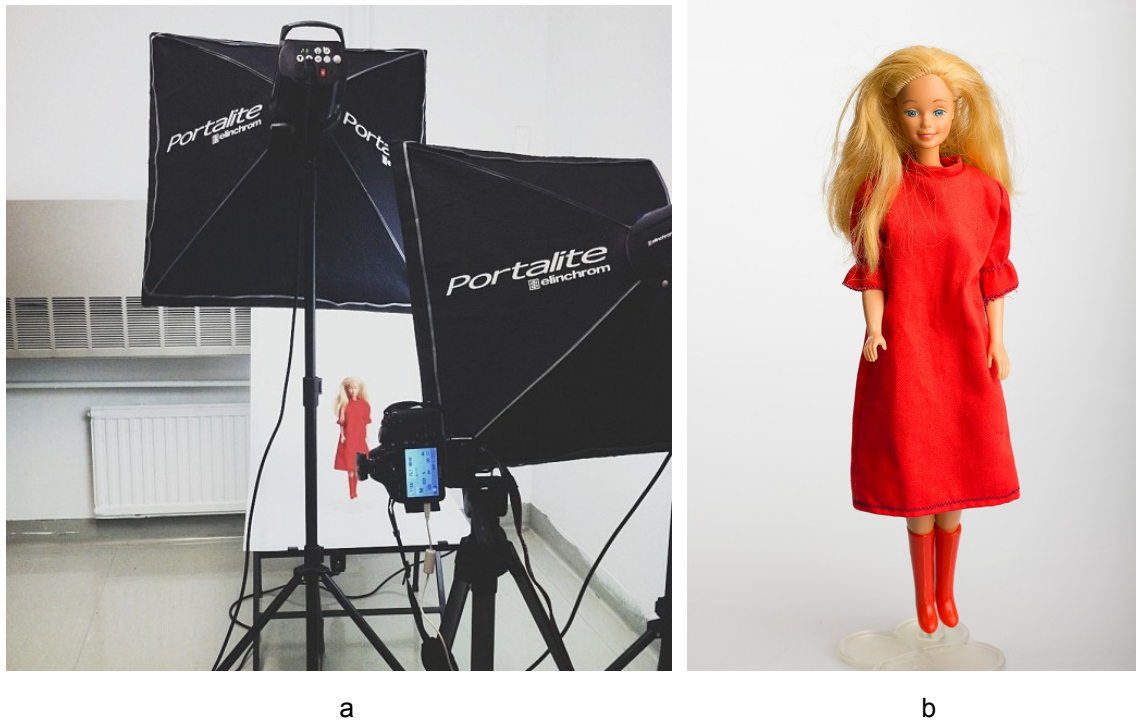


Figure 21. Studio setup and an example image produced with it

The setups demonstrated in Figure 20 and Figure 21 ended up being used for most of the final shots. Lighting from the top was more useful for full-height shots while the setup with both lights in front was used for the close-up portraits. The setups were adjusted for each setting and subject by moving the flash units higher or lower as well as closer or further away from the subject. The position of the reflector was adjusted accordingly.

A Canon EOS 550D camera was used to capture all of the images for this project. It is an entry-level DSLR, which was good enough for product shots in an environment with controlled lighting. It was used with a Canon EF 50mm f/1.8 lens, which is a long enough lens for the camera and tripod to be comfortably placed into the small studio setup. It also has a wide aperture, which is useful for trying out different depth of field for different tabletop shots.

The camera was connected to a laptop with a USB cable. That way the pictures could be taken using camera controlling software instead of pressing the button on the camera. This also allowed to avoid unnecessary camera shaking. In addition, all of the shots could be saved straight to the computer and analyzed visually on the go. Canon EOS Utility software, that comes within 550D package, was used to control the camera (Figure 22). Adobe Bridge CS5 was also used to assess the images visually and numerically on the go.

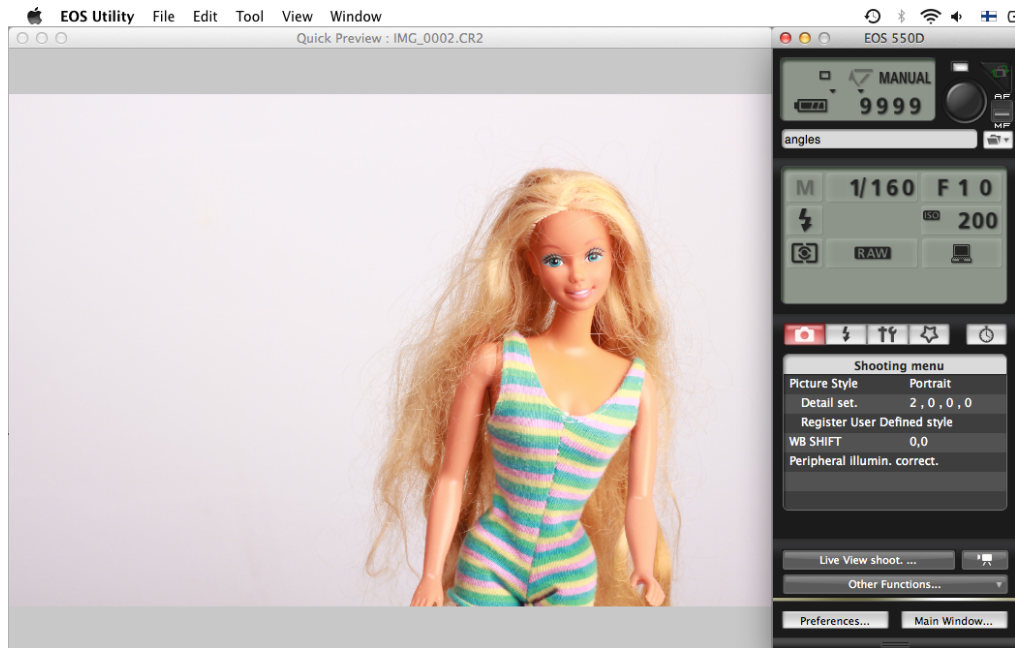


Figure 22. Using EOS Utility for remote shooting

An example of the basic camera settings used for producing the photographs is shown in Figure 22. The most suitable shutter speed was found to be 1/160 with the Skyport set to the “Standard” mode. When the shutter speed was set to higher values the photographs had a dark band over the bottom. The aperture and ISO values were set for each lighting setup separately. These settings were used to control the image exposure along with manually moving the flash units towards or away from the scene. The aperture values used varied between 5.6 and 10. ISO values were switched from 100 to 200 and back when necessary.

The camera was placed at different angles for different shots. Though, for most of the shots, especially close-ups, the best position of the camera was found to be the one in which the dolls appeared to be looking into the camera. The photographs shot with this camera positioning made the dolls look more “alive” which gave them more character and made them look more attractive to the viewer. The camera position was adjusted for each doll separately, because each of them had a different gaze.

### 3.2 Workflow

After all of the equipment, techniques and possible setups were tested, a general workflow for the final photography production was developed. Figure 23 demonstrates the workflow implemented for this project.

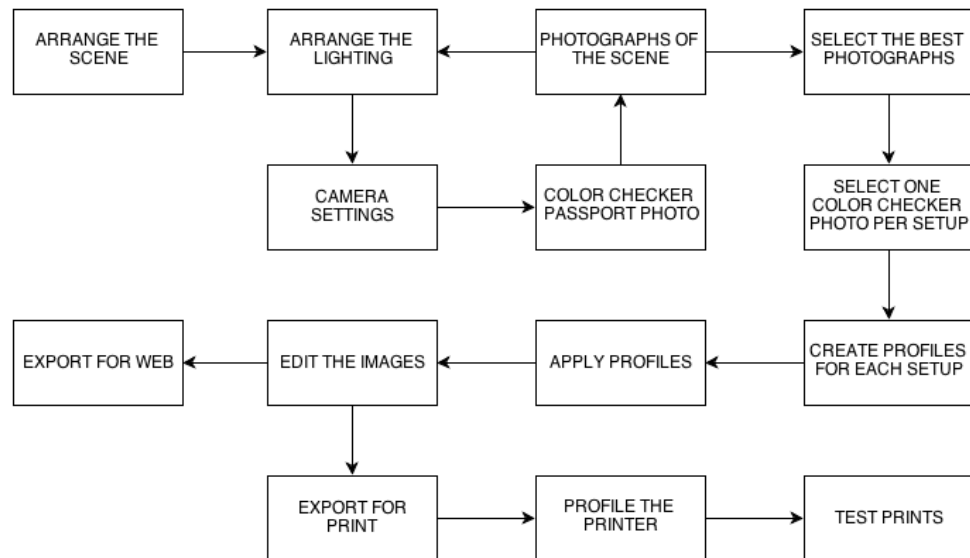


Figure 23. Workflow process chart

The first step was arranging the scene on the table. Since the photographs were expected to be used in an online store as well as in print, the scenes were very simple with no special backgrounds and almost no props to clearly show the products. In some of the scenes a small amount of props was used, such as chairs for the dolls.

After the scene was ready the flash units were arranged to light it up properly. The ceiling light in the studio was switched off and only the modeling light from the flash units was used to arrange the strobes. A few test photographs were taken in order to assess light arrangement and test the exposure. The camera was set to the manual mode and the aperture and shutter speed settings were set separately for each new scene. RAW format was selected from the camera settings before the shoot because it gives more user control and flexibility for color correction as well as color management. Once the light sources were in place and the exposure was set the ColorChecker Passport was placed in the scene and photographed with no changes in camera settings except for the focus which was adjusted for the target (Figure 24).



Figure 24. Using color checker passport.

Afterwards all the necessary photos of the scene were taken. The scene was changed as much as it was needed as long as the lighting setup stayed the same. Whenever the lighting had to be adjusted, the ColorChecker Passport was placed in the scene again and photographed before the rest of the photographs with the new lighting arrangement were taken. This process was repeated every time the lighting needed to be changed.

When the session was over the folder with the photographs was opened in Adobe Bridge CS5, the photographs were assessed visually and the best ones were selected for future editing. The photographs with a ColorChecker Passport target were assessed separately and one target photograph for each lighting setup was selected for profile creation. To create a profile the photograph with a target was opened in Adobe Camera Raw, saved in DNG format by pressing “Save Image” button and opened in ColorChecker Passport software (Figure 25) that comes in a package with the target.

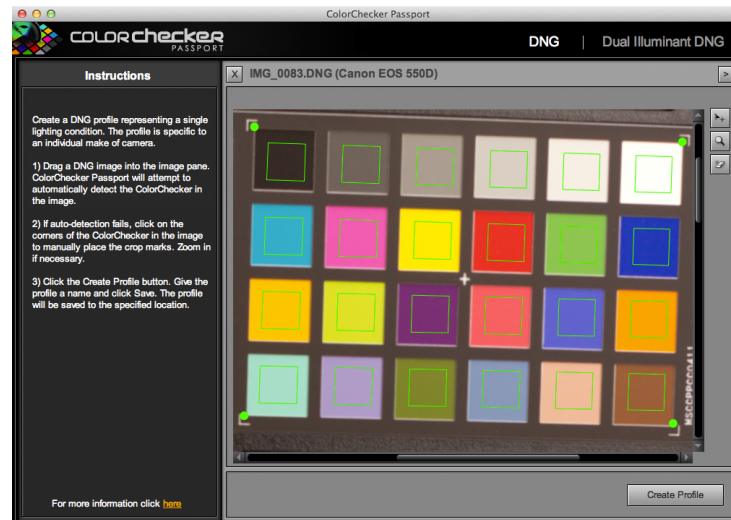


Figure 25. Creating profiles in ColorChecker Passport software

The software identified the target in the photographs automatically (Figure 25) and profiles were created by pressing the “Create Profile” button. A name for the profile was specified and an appropriate location was selected, which for Camera Raw is (on a Mac) Library - Application Support - Adobe - CameraRaw - CameraProfiles. Figure 26 demonstrates how the profiles created with ColorChecker Passport were applied to multiple images using Adobe Bridge and Camera Raw.

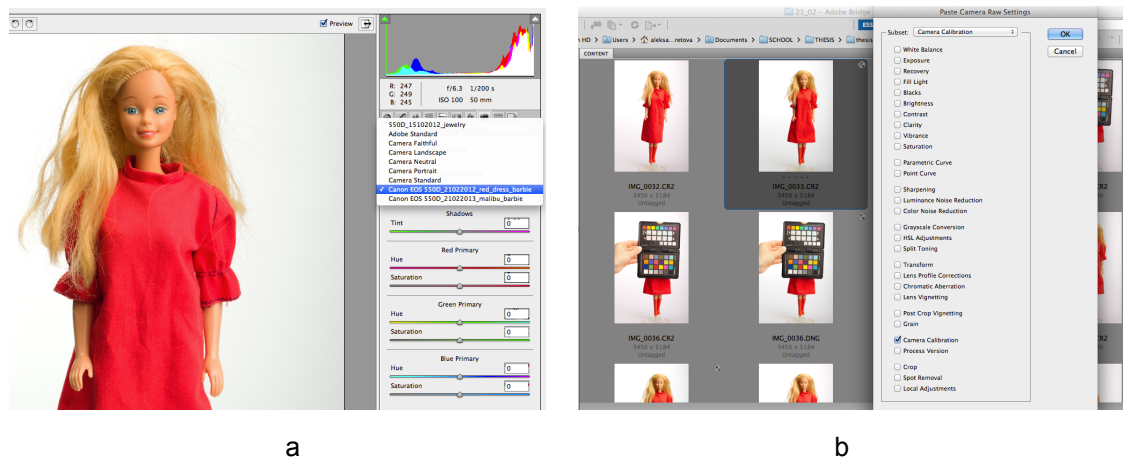


Figure 26. Camera Calibration Settings in Adobe Camera Raw

One photograph from the set with the same lighting conditions was opened in Camera Raw and the new camera profile was applied to it from the “Camera Calibration” tab in Camera Raw settings (Figure 26a). The settings for that image were then saved and the image was closed. The settings on that image were copied by right clicking on it in Adobe Bridge CS5 and selecting “Develop Settings - Copy Settings”. Afterwards all the rest of the images in the set were selected in Adobe Bridge and the copied settings

were pasted by right clicking on one of the selected images and pressing “Develop Settings - Paste Settings”. From the dialog that opened afterwards (Figure 26b) “Camera Calibration” was selected in the drop down list. Clicking “OK” applied the settings to all of the selected images.

The same workflow can be used for applying all of the other Camera Raw settings for multiple images. All of the corrections can be done to one image alongside with applying the profile and then pasted to the rest of the images shot in the same lighting conditions by selecting “Everything” in the drop down list of the “Paste Camera Raw Settings” dialog (Figure 26b).

When all necessary edits were done in Adobe Camera Raw, the photographs were opened in Adobe Photoshop CS5 and color correction was done when needed using the techniques described in section 2.2. There were mostly minor corrections done since no special effects were required and color management was taken care of all the way, so the colors were expected to look right when images were imported in Photoshop. Some blemishes were removed using the “Spot Healing Brush Tool” and the “Patch Tool”, but even these procedures had to be taken to a minimum due to the vintage nature of the product. The photographs were required to properly show the “signs of wear” on the dolls so that the customers can see the condition of the vintage items they are buying.

The original image files were then saved in PSD format which keeps all adjustment layers in case more corrections need to be done later. The output files were exported in JPEG format. There were different files created for print and online use. The “Image Size” dialog accessible from the “Image” menu in Photoshop was used to adjust the size of the files.

As a result there were two sets of photographs delivered to the customer. Both sets included photographs of each doll in different positions from different angles. There were full height photographs as well as close-ups mostly on doll faces but also on clothes details where necessary. There were some photographs done with the props provided by the customer, such as having the dolls sit on a chair or hold a handbag. The first set contained all those photographs with the settings suitable for online use. The second set had the exact same photographs with the settings suitable for printing. Figure 27 demonstrated different types of product shots created as a result of this project, such as full-height shots, close-ups and shots done with the use of props.





Figure 27. Types of product shots

The test prints were done on an Epson Stylus Pro 4900 printer. A couple of images saved for print were selected and printed first with the use of a standard paper profile found within the software. Afterwards custom output profiles were created for the printer and the same images were printed again using the new profiles. The printed results were compared afterwards.

For test prints the resolution was set to 300 ppi and the size of the image was adjusted for the desirable print size. Since the print size required for the customer was uncertain and the file storage space was not an issue, the images intended for print were saved with the resolution of 300 ppi keeping the original pixel count. That way the customer could use those images in the future for as large print as the original pixel count would allow and resize the images themselves if smaller print sizes were needed. For web use the embedded profiles of the image files were converted to sRGB, the resolution was set to 72 ppi and the size was reduced to 1200 px wide along the larger side. This size was chosen because it is large enough to showcase the images on the web and keep the best quality but not too large to upload on the online store service used by the customer.

### 3.3 Color management

Monitor profiling was implemented using the i1 Pro spectrophotometer with i1 Profiler software. The spectrophotometer was attached to a monitor holder that comes with i1 Basic Pro package and placed on a monitor for accurate hands free profiling. The i1 Profiler software includes a Basic and an Advanced mode for monitor profiling. For this project the Advanced mode was used and a profile was created using D65 for white point and 120 cd/m<sup>2</sup> for luminance. The tone response curve was set to gamma 2.2. A medium default patch set as well as a large default patch set were tested for performing the measurement. As a result of the measurement two display profiles were created and applied in turns to the monitor in the display settings. The two profiles resulted in similar color performance, though the one created with the large set of patches resulted in slightly better color appearance.

For camera profiling the ColorChecker Passport package from X-Rite was used. The package includes a pocket-size target and the software capable of building camera profiles from the photographs of the target. The camera profiling workflow performed for this project is described in the previous subchapter.

The settings in Adobe Photoshop SC5 and Adobe Bridge SC5 were set to “Europe Prepress 3” preset with Adobe RGB (1998) working space for RGB images and Coated FOGRA39 (ISO 12647-2:2004) working space for CMYK files. RAW workflow was followed, as described above, and all of the images were tagged with Adobe RGB profile when converted to JPEG.

Soft proofing was also used to preview the images before saving them for use in print and necessary edits were done to those files. Two output profiles were used for soft proofing: printer profile created for the printer used for test prints as well as the working space CMYK. Soft proof with working space CMYK was assessed because the customer did not specify how the photographs were going to be printed in the future. So a general assessment of how the colors would change when converted to CMYK was enough for this project.

There were two different printer profiling workflows tested for this project on Epson Stylus Pro 4900. The first workflow was performed using a user-friendly photographer-oriented application Mirage Print (Figure 28). The second workflow involved a much more advanced EFI XF software package (Figure 29). Before the profiles were created a test image was printed with Epson’s standard paper settings for the paper used.



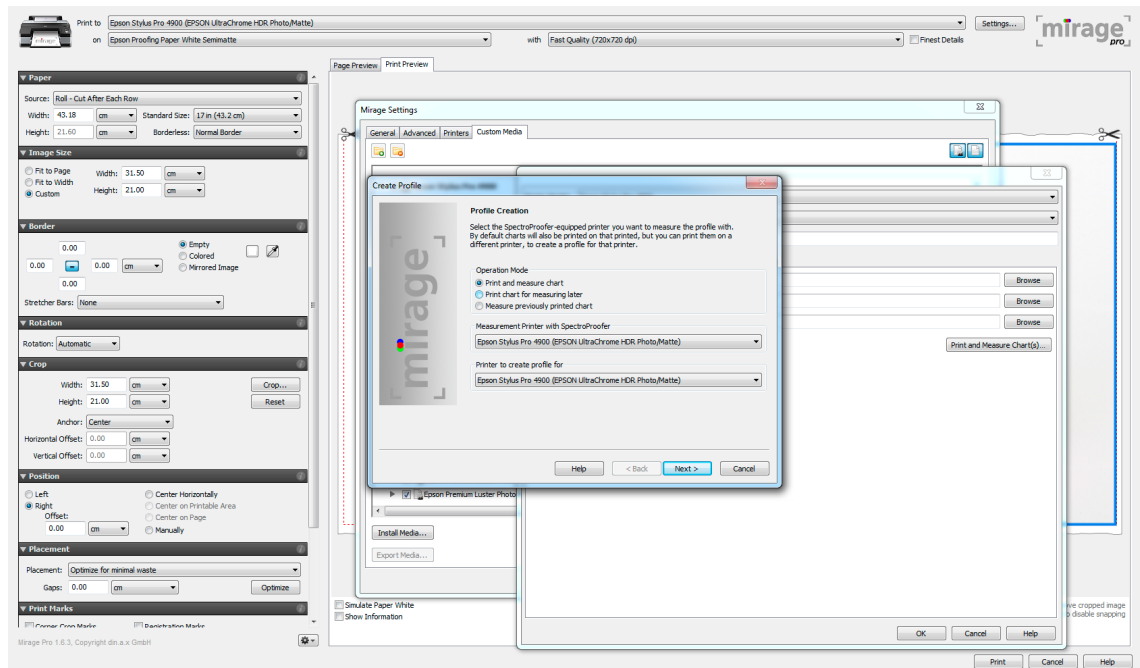


Figure 28. Creating a profile in Mirage Print

Most of the profiling process with Mirage Print is done automatically when it is working in conjunction with a printer such as Epson Stylus Pro 4900, which has a built-in SpectroProofer for measuring the targets. When Mirage print software has started, the list of available media was opened from the “Settings” menu. “Add Media” button was pressed to start creating a new printer profile. The next steps included selecting the printer and a default paper to base the new profile on, choosing a name for the profile, specifying paper type and size, selecting a chart type between small, standard and extended as well as the print quality to create the profile for. After these basic settings were complete the rest of the process was performed automatically by the printer and Mirage Pro software.

The EFI XF package includes a software called EFI Color Manager which is used for creating profiles. Profiling with this software is a more advanced process that includes several steps. Before the actual profile creation an extra step called linearization needs to be done. For linearization several targets were printed and measured. These targets included strips of patches for different colors from the darkest to the lightest. One of the targets also required visual assessment by the user. Figure 28 demonstrates some of the settings that needed to be set by the user before starting linearization process.

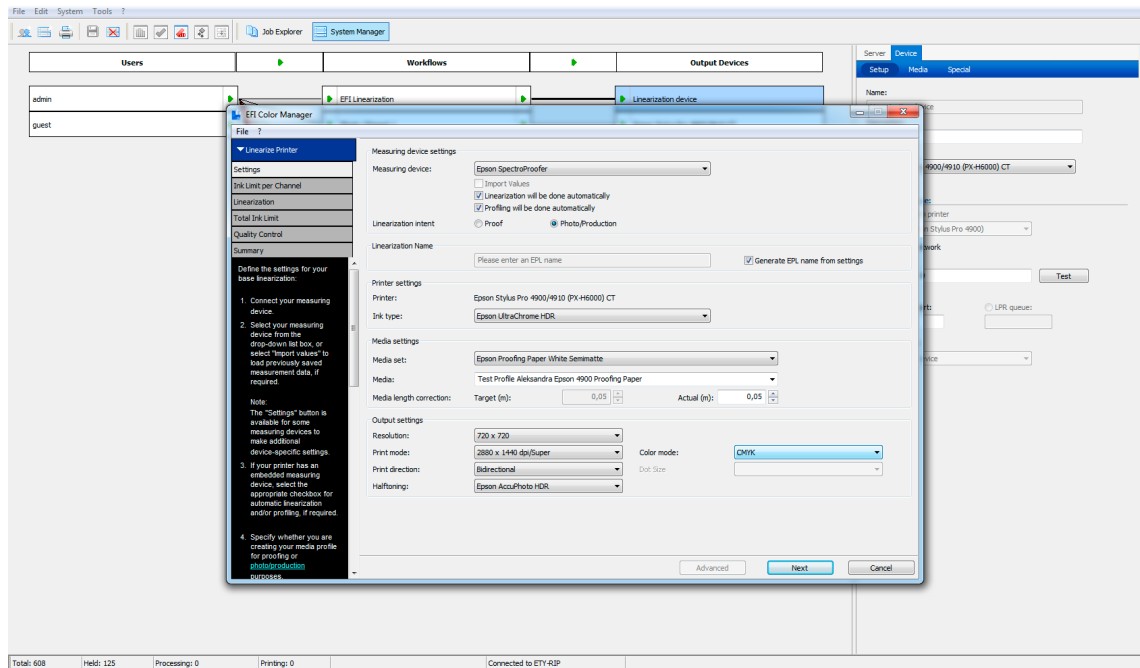


Figure 29. Creating a profile in EFI Color Manager

The SpectroProofer built into the Epson Stylus Pro 4900 allows automatic measuring of the targets, but they can also be measured by a separate spectrophotometer such as the ones shown in Figure 16. After all the linearization steps were done, the profile creation was initiated. A large set of patches was printed and measured to create the profile. Measuring profiling targets was also done automatically by SpectroProofer, but could be performed by a separate spectrophotometer.

After two new custom profiles were created, the same test image as printed before the profiling was printed again using each of those profiles. The resulting prints were compared and assessed visually in comparison to the soft proofs on a display as well as real-life colors of the products photographed. Both custom profiles provided better color representation than the Epson's standard paper profile. The results of the two custom profiles were similar to each other, though the image printed using the profile created in EFI Color Manager was slightly closer to the soft proof.

## **4 Discussion**

### **4.1 Compact vs professional studio setup**

Different lighting setups were tested and compared during this project. Some were found to give better results than others. The setups that gave better results were eventually used to produce the photographs for the client. On the other hand, none of the setups produced perfect results in terms of lighting both the background and the subject evenly. In most of the final photographs there is a slight gradient in the background from lighter to darker gray.

A possible reason for this could be the limited equipment used. The available set of flash units and accessories was designed for traveling and compact storage and a small reflector was the only additional lighting accessory used. A more professional studio setup would include more light sources used with different light shaping accessories such as the ones described in subsection 2.1.3. Larger soft boxes would provide more diffused light while reflectors and white cards of different sizes would bounce the light to more directions.

Nevertheless, the results produced with the available compact setup were approved by the customer and were acceptable for use in the online shop as well as in print. In many cases the uneven lighting could be color corrected in Photoshop. The color correction process was quite fast and did not require any major editing. This type of setup was found to be good enough for fast and compact product photography on a budget.

### **4.2 Working with digital images**

After the photographs were shot in the studio the rest of the project involved working with digital images. Since one of the goals was preparing the images for printing, color management was implemented as a part of the overall workflow. During the process it has shown to be a very important part of working with digital images regardless of whether the final destination was online or print. Including color management as part of the workflow and taking it into account at every step does not only allow better control over the color consistency but also saves a lot of time on editing and test printing.

In this project minimum color adjustments were done to the images in Photoshop, because color consistency was taken care of during shooting using color management techniques such as camera and display profiling. In some of the cases camera profiles failed to work. They did not improve the camera's color representation in some of the setups. To compensate for that the images were opened with Adobe Camera Raw and the colors were adjusted using the two color sliders within the "White Balance" section. The actual products were used as a reference.

To check the accuracy of the colors when adjusting the white balance the images were analyzed both visually and numerically by hovering the mouse over the neutral gray areas in Adobe Camera Raw. The colors were adjusted until each of the RGB colors had the same values in the areas that needed to be neutral. This process was not automatic compared to applying a camera profile, but it was good enough for adjusting the camera's color representation and saved time on color correction in Photoshop.

RAW workflow allowed more control over the colors and saved a lot of time on editing in a similar manner. Slight adjustments of white balance as well as other controls made major color adjustments in Photoshop unnecessary. There was also no color management done by the camera itself which allowed great control over color consistency and profile embedding.

Less time and resources can also be spent on printing when both printer and display are properly profiled and soft proofing is used. There is much less chance further editing is needed after the first test prints. In addition, the limitations of the printer are more expected and can be prepared for with additional editing when soft proofing is used. In this project the test prints' colors were very close to the soft proofs and therefore accepted by the customer. No additional editing was done after test prints were ready, which also saved a lot of time.

### **4.3 Preparing for print vs online use**

The images created during this project needed to be suitable both for print and for online use. As a result, there were two sets of images created as the quality of the images for those two different uses needed to be quite different. The image size and resolution is different for print and web. Printed images need to have large enough resolution for acceptable output quality and the size needs to correspond with the output size. The images uploaded to the web, on the other hand, need to be as small as possible as long as the image quality allows, to save the server space as well as the

loading time. Images sizes used on the web are also generally smaller than those of printed images.

Color management is another aspect that is executed differently when preparing images for print and online use. In printing workflow the user is handling color management techniques by his/her own all the way. Even when the final product is printed by an outside print service, in most of the cases they can provide with printer profiles for soft proofing as well as hard proofs of the final product for approval before printing the whole run. Therefore, when all color management techniques are applied appropriately the user can have complete control over the color reproduction of the images in printing workflow. The only aspect that can make the colors vary is the temperature of the lighting under which the printed images are viewed. In order for this to not affect the workflow, printed images should always be viewed under special light sources that produce neutral light of 5000k. The only part of the process that is not possible to control is the viewing conditions of the end customers.

Color management for the online use is not handled completely by the person or company creating the images. Even when uploaded to company's own website, the web browsers apply their own color management settings which the user cannot control in any way. The solution for that was found to be converting all images to sRGB as most of the browsers use this color space. Tagging images with sRGB profile is also useful if the file size allows it as some of the browsers recognize embedded profiles. On the other hand, even if the user gets his/her browser to reproduce the colors correctly by applying one or both of those techniques there is still no control of how the end customers will perceive the image. Most of the customers browsing online shops do not profile their displays which lead to each of them having different color representations of the same images. They also use different browsers of different versions, which all apply their own color management techniques. Therefore, it is not possible to completely control color representation of the images that are used online.

## 5 Conclusions

The main goals for this project were the production of product photographs for the customer for print and online use as well as comparison of the workflows for these two different outputs. As a result all necessary photographs of all the products provided by the customer were produced successfully. The customer approved the results shown both on a display and in print.

The photographs were prepared for both print and online use and the differences in the two workflows were identified. The main differences found were the size and resolution of the images that needed to be different for those outputs as well as different approach to color management. The color management techniques were similar on the first stages of the production, but got quite different at the last stages such as dealing with file size, saving the files and tagging them with profiles.

One of the main strengths of this project was carefully color managed workflow which saved time on editing the images and producing the test prints for the customer. All of the devices used in this project were profiled, all of the applications used were ICC-aware and all of the images were tagged with appropriate profiles. This allowed great control over color consistency on all stages of the production.

One of the main weaknesses was the use of a limited lighting setup for the studio photography. The setup was enough for producing acceptable results. Nevertheless, in many situations there was not enough possibility to shape the desired light over the scene. If this project was carried out again it would be useful to have more variety of available product photography equipment and accessories.

During this project I learned a lot about lighting for product photography and for studio photography in general. The theoretical research of all the lighting tools and accessories provided a lot of information on the possibilities of a professional studio setup. The lighting setup used for this project was very useful for experimenting with different lighting techniques as well as for learning to work with studio lighting. It was found to be good enough for producing acceptable product photography results and could give even better results with more practice. Some of the color management techniques as well as image editing tools were also new to me. In addition, I acquired a lot of experience in planning a whole production workflow from the beginning to the end based on the customer requirements.

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